

特 許 協 力 条 約

PCT

特許性に関する国際予備報告 (特許協力条約第二章)

(法第12条、法施行規則第56条)
(PCT 36条及びPCT規則70)

REC'D 16 DEC 2004

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出願人又は代理人 の書類記号 NGK-44-PCT	今後の手続きについては、様式PCT/IPEA/416を参照すること。	
国際出願番号 PCT/JPO3/10887	国際出願日 (日.月.年) 27.08.2003	優先日 (日.月.年) 27.08.2002
国際特許分類 (IPC) Int. Cl. G01N27/409, G01N27/416, G01N27/12, G01N27/41, G01N27/419		
出願人 (氏名又は名称) 日本特殊陶業株式会社		

1. この報告書は、PCT 35条に基づきこの国際予備審査機関で作成された国際予備審査報告である。
法施行規則第57条 (PCT 36条) の規定に従い送付する。
2. この国際予備審査報告は、この表紙を含めて全部で 4 ページからなる。
3. この報告には次の附属物件も添付されている。
a ☒ 附属書類は全部で 7 ページである。
☒ 補正されて、この報告の基礎とされた及び/又はこの国際予備審査機関が認めた訂正を含む明細書、請求の範囲及び/又は図面の用紙 (PCT規則70.16及び実施細則第607号参照)
☐ 第I欄4. 及び補充欄に示したように、出願時における国際出願の開示の範囲を超えた補正を含むものとこの国際予備審査機関が認定した差替え用紙
b ☐ 電子媒体は全部で (電子媒体の種類、数を示す)。
配列表に関する補充欄に示すように、コンピュータ読み取り可能な形式による配列表又は配列表に関連するテーブルを含む。 (実施細則第802号参照)
4. この国際予備審査報告は、次の内容を含む。
- ☒ 第I欄 国際予備審査報告の基礎
 - ☐ 第II欄 優先権
 - ☐ 第III欄 新規性、進歩性又は産業上の利用可能性についての国際予備審査報告の不作成
 - ☐ 第IV欄 発明の単一性の欠如
 - ☒ 第V欄 PCT 35条(2)に規定する新規性、進歩性又は産業上の利用可能性についての見解、それを裏付けるための文献及び説明
 - ☐ 第VI欄 ある種の引用文献
 - ☐ 第VII欄 国際出願の不備
 - ☐ 第VIII欄 国際出願に対する意見

国際予備審査の請求書を受理した日 25.03.2004	国際予備審査報告を作成した日 25.11.2004	
名称及びあて先 日本国特許庁 (IPEA/JP) 郵便番号100-8915 東京都千代田区霞が関三丁目4番3号	特許庁審査官 (権限のある職員) 黒田 浩一	2 J 9 2 1 8
	電話番号 03-3581-1101 内線 3251	

様式PCT/IPEA/409 (表紙) (2004年1月)

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1. この国際予備審査報告は、下記に示す場合を除くほか、国際出願の言語を基礎とした。

2. この報告は下記の出願書類を基礎とした。(法第6条(PCT14条)の規定に基づく命令に応答するために提出された差替え用紙は、この報告において「出願時」とし、この報告に添付していない。)

- 付けで国際予備審査機関が受理したもの

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3. ☒ 補正により、下記の書類が削除された。

4. ☐ この報告は、補充欄に示したように、この報告に添付されかつ以下に示した補正が出願時における開示の範囲を越えてされたものと認められるので、その補正がされなかったものとして作成した。(PCT規則70.2(c))

- * 4. に該当する場合、その用紙に “superseded” と記入されることがある。

第V欄 新規性、進歩性又は産業上の利用可能性についての法第12条(PCT35条(2))に定める見解、
それを裏付ける文献及び説明

1. 見解

新規性 (N)	請求の範囲	1, 3, 4, 7, 8, 9, 10, 11, 12, 13	有
	請求の範囲		無
進歩性 (IS)	請求の範囲	7, 8, 9, 10, 11, 13	有
	請求の範囲	1, 3, 4, 12	無
産業上の利用可能性 (IA)	請求の範囲	1, 3, 4, 7, 8, 9, 10, 11, 12, 13	有
	請求の範囲		無

2. 文献及び説明 (PCT規則70.7)

- 文献1 : JP 2002-236105 A(ローベルト ボツシユ ゲゼルシヤフト
ミツト ベシユレンクテル ハフツング) 2002. 08. 23
全文、第1図
& US 2002/0053233 A1 & DE 10058013 A
- 文献2 : JP 2001-343356 A(株式会社デンソー) 2001. 12. 14
全文、第12図 & US 2001/0025522 A1
- 文献3 : JP 2001-99807 A(日本特殊陶業株式会社) 2001. 04. 13
全文、第1-11図 & EP 978721 A1 & US 6346179 B1

請求の範囲1, 3, 12

国際調査報告で引用した文献1, 2には、軸方向に延びると共に、先端部に被測定ガスに被測定ガスに接触させるガス接触部を有するガス検出素子と、前記ガス接触部を先端から突き出させた状態で前記ガス検出素子の径方向周囲を取り囲むケースと、前記ガス検出素子の前記ガス接触部を覆うように、前記ケースに固定させた有底筒状のプロテクタと、を備えたガスセンサであって、前記プロテクタは内側筒状部と、この内側筒状部の側壁に空隙を介し同軸状に配置した外側筒状部とを備え、前記内側筒状部を有底筒状に形成すると共に、前記外側筒状部を有底筒状に形成し、前記外側筒状部の底壁に設けた挿通孔に前記内側筒状部を挿通して、この外側筒状部の底壁より先端側に前記内側筒状部の底壁を突き出させ、この外側筒状部の底壁を当該プロテクタの最先端側に位置する底壁とし、前記外側筒状部の側壁に、被測定ガスを前記空隙に導入するための複数の外壁ガス導入口を形成し、前記内側筒状部の側壁に、被測定ガスを前記ガス接触部の周囲に導入するために、前記外壁ガス導入口よりも前記ケースの近傍に配置した複数の内壁ガス導入口を形成し、且つ、前記外壁ガス導入口に対向する位置における内側筒状部の側壁の外周面を、前記外側筒状部の側壁の外周面と平行に形成し、前記プロテクタの最先端側に位置する前記底壁に、前記内側筒状部に内部に導入された被測定ガスを直接当該プロテクタの外部に排出するための排出口を形成し、前記外側筒状部の底壁よりも先端側に突き出す前記内側筒状部の側壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成した、ガスセンサが、記載されている。

そして、国際調査報告で引用した文献3には、ガスセンサにおいて、外側筒状のガス導入口に内側に向けて延出するガイド体を付設したものが記載されているから、係る構成を文献1, 2に記載のガスセンサに採用することは、当該技術分野の専門家にとって容易に想到する事項である。

補充欄

いずれかの欄の大きさが足りない場合

第 V 欄の続き

請求の範囲 4

国際調査報告で引用した文献 3 の第 8 図 (f) には、外側筒状部の底壁を、自身の外径が先端側に向かって小径となるようにテーパをつけて形成した構成が記載されているから、引用例 1, 2 に記載のガスセンサの外側筒状部を係る構成とすることに何ら技術的困難性は認められない。

請求の範囲 7, 8, 9, 10, 11, 13

国際調査報告で引用したいずれの文献にも、外側筒状部の底壁うち、内側筒状部の側壁の外周面よりも径方向外側に位置する部分に水抜き孔を形成する点、及び、外側筒状部の底壁は、外側筒状部の側壁に連結する第 1 底壁と、この第 1 底壁よりも先端側に配置される第 2 底壁を有し、前記第 2 底壁に排出口を形成しており、前記第 1 底壁と第 2 底壁とを連結する連結側壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成した点が、記載も示唆もされていない。

外径が先端側に向かって小径となるようにテーパを付けて形成しているので、外側筒状部の底壁よりも先端側に突き出した内側筒状部の側壁部におけるテーパの効果と相まって、両テーパに沿って流れるガス流がより円滑に発生することになる。これにより、プロテクタ内における被測定ガスの置換が一層良好になり、被測定ガス中のガス成分を検出する応答速度と検出精度を一層向上させることができる。

尚、請求項 3 又は請求項 4 に記載のガスセンサにおいて、外側筒状部の底壁から突き出してテーパを有する内側筒状部の突き出し寸法は、1 mm ~ 5 mm の範囲であれば、被測定ガス中のガス成分を検出する応答速度と検出精度を向上できることが、本発明の発明者によって確認されている。

また、上記請求項 3 又は請求項 4 に記載のガスセンサにおいて、内側筒状部の上記テーパの角度は、内側筒状部の底壁とこのテーパとの交わる外角を β としたときに、 $30^\circ \leq \beta \leq 60^\circ$ の範囲内にあることが好ましい。上記外角 β をこのような範囲内に設定することで、テーパに沿って流れるガス流を円滑に発生させることができる。さらに、ガスセンサのセンサ軸を排気管に対して傾斜させて取り付けることにより、センサ軸と被測定ガスの流れ方向の位置関係が異なることがあっても、上記 β を上記範囲内に設定することで、プロテクタ内の被測定ガスの置換を良好に行うことが可能となり、ガスセンサの取付け方向、取付け角度に依存されることなく、ガスセンサの応答速度と検出速度を良好に得ることができる。

次に、請求項 5 に記載の発明は、請求項 1 に記載のガスセンサにおいて、前記外側筒状部を有底筒状に形成し、前記外側筒状部の底壁を前記内側筒状部よりも先端側に配置させて前記プロテクタの最先端側に位置する底壁とし、この外側筒状部の底壁に前記排出口を形成することが好

ましい。

請求の範囲

1. (補正後) 軸方向に延びると共に、先端部に被測定ガスに接触させる
5 ガス接触部を有するガス検出素子と、

前記ガス接触部を先端から突き出させた状態で前記ガス検出素子の径
方向周囲を取り囲むケースと、

前記ガス検出素子の前記ガス接触部を覆うように、前記ケースに固定
させた有底筒状のプロテクタと、

10 を備えたガスセンサであって、

前記プロテクタは、内側筒状部と、この内側筒状部の側壁に空隙を介
し同軸状に配置した外側筒状部とを備え、

前記内側筒状部を有底筒状に形成すると共に、前記外側筒状部を有底
筒状に形成し、前記外側筒状部の底壁に設けた挿通孔に前記内側筒状部
15 を挿通して、この外側筒状部の底壁より先端側に前記内側筒状部の底壁
を突き出させ、この内側筒状部の底壁を当該プロテクタの最先端側に位
置する底壁とし、

前記外側筒状部の側壁に、被測定ガスを前記空隙に導入するために、
内側に向けて延出するガイド体を付設した複数の外壁ガス導入口を形成
20 し、

前記内側筒状部の側壁に、被測定ガスを前記ガス接触部の周囲に導入
するために、前記外壁ガス導入口よりも前記ケースの近傍に配置した複
数の内壁ガス導入口を形成し、且つ、前記外壁ガス導入口に対向する位
置における内側筒状部の側壁の外周面を、前記外側筒状部の側壁の外周
25 面と平行又は前記プロテクタの底壁に向かう軸方向に径が大きくなる斜
面状に形成し、

前記プロテクタの最先端側に位置する前記底壁に、前記内側筒状部の内部に導入された被測定ガスを直接当該プロテクタの外部に排出するための排出口を形成した、

ことを特徴とするガスセンサ。

5 2. (削除)

3. (補正後) 前記外側筒状部の底壁よりも先端側に突き出す前記内側筒状部の側壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成し、前記外側筒状部の底壁から突き出して前記テーパを有する内側筒状部の突き出し寸法が、1 mm～5 mmの範囲にあることを
10 特徴とする請求項1に記載のガスセンサ。

4. (補正後) 前記外側筒状部の底壁よりも先端側に突き出す前記内側筒状部の側壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成し、前記外側筒状部の底壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成したことを特徴とする請求項
15 1に記載のガスセンサ。

5. (削除)

6. (削除)

7. (補正後) 前記外側筒状部の底壁のうち、前記内側筒状部の側壁の外周面よりも径方向外側に位置する部分に少なくとも一つ以上の水抜き孔
20 を形成したことを特徴とする請求項1乃至請求項4の何れか記載のガスセンサ。

8. (補正後) 前記内側筒状部の側壁のうちで前記外側筒状部の内部に位置する部位には、水抜き孔が形成され、

この水抜き孔は、自身の内周縁の中で前記プロテクタの軸方向の先端
25 側に位置する先端側端縁が、前記外側筒状部の側壁の最も先端側に位置する前記外壁ガス導入口の内周縁の中で前記プロテクタの軸方向の後端

側に位置する後縁側端縁よりも、前記プロテクタの軸方向の先端側に位置するように、

形成されていることを特徴とする請求項 1 乃至請求項 4 の何れか記載のガスセンサ。

- 5 9. 前記水抜き孔の内周縁の後端側端縁に一端が連結され、他端が、該水抜き孔の後端側端縁から当該プロテクタの先端側に向かって当該プロテクタの径方向の中心に近づくように傾斜して延出された第二のガイド体、

を備えたことを特徴とする請求項 8 に記載のガスセンサ。

- 10 10. 前記内側筒状部の側壁の一部において、前記プロテクタの軸方向に対して交差する切り目を設け、この切り目からプロテクタの軸方向の後端側の部位が前記内側筒状部の側壁に連なる形態で径方向の内側に向かって突出されることにより、前記プロテクタの軸方向に延設された第2のガイド体と前記水抜き孔が構成されることを特徴とする請求項 8 に記載のガスセンサ。

11. 前記内側筒状部の側壁には、前記水抜き孔が複数形成され、

該複数の水抜き孔の総開口面積は、前記複数の内壁ガス導入口の総開口面積よりも小さいことを特徴とする請求項 8 乃至請求項 10 の何れか記載のガスセンサ。

- 20 12. 前記ガイド体は、

前記外壁ガス導入口の端部から延出する角度が、外側筒状部の外周の接線に対し、内側に向け、 35° 以上 70° 以下の範囲内になるように、

形成されていることを特徴とする請求項 1 乃至請求項 11 の何れか記載のガスセンサ。

13. (追加) 軸方向に延びると共に、先端部に被測定ガスに接触させるガス接触部を有するガス検出素子と、

5 前記ガス接触部を先端から突き出させた状態で前記ガス検出素子の径方向周囲を取り囲むケースと、

前記ガス検出素子の前記ガス接触部を覆うように、前記ケースに固定させた有底筒状のプロテクタと、

を備えたガスセンサであって、

10 前記プロテクタは、内側筒状部と、この内側筒状部の側壁に空隙を介し同軸状に設置した外側筒状部とを備え、

前記外側筒状部を有底筒状に形成し、前記外側筒状部の底壁を前記内側筒状部よりも先端側に配置させて前記プロテクタの最先端側に位置する底壁とし、

15 前記外側筒状部の側壁に、被測定ガスを前記空隙に導入するために、内側に向けて延出するガイド体を付設した複数の外壁ガス導入口を形成し、

前記内側筒状部の側壁に、被測定ガスを前記ガス接触部の周囲に導入するために、前記外壁ガス導入口よりも前記ケースの近傍に配置した複数の内壁ガス導入口を形成し、且つ、前記外壁ガス導入口に対向する位置における内側筒状部の側壁の外周面を、前記外側筒状部の側壁の外周面と平行又は前記プロテクタの底壁に向かう軸方向に径が大きくなる斜面状に形成し、

20 前記プロテクタの最先端側に位置する前記底壁に、前記内側筒状部の内部に導入された被測定ガスを直接当該プロテクタの外部に排出するための排出口を形成し、

前記外側筒状部の底壁は、前記外側筒状部の側壁に連結する第1底壁と、この第1底壁よりも先端側に配置される第2底壁を有し、前記第2底壁に前記排出口を形成しており、前記第1底壁と前記第2底壁とを連結する連結側壁を、自身の外径が先端側に向かって小径となるようにテーパを付けて形成した、

5

ことを特徴とするガスセンサ。

Translation

Rec'd PCT/PTO 25 FEB 2005

PCT/JP2003/010887

PATENT COOPERATION TREATY



PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference NGK-44-PCT	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/JP2003/010887	International filing date (day/month/year) 27 August 2003 (27.08.2003)	Priority date (day/month/year) 27 August 2002 (27.08.2002)
International Patent Classification (IPC) or national classification and IPC G01N 27/416, 27/409, 27/12, 27/41, 27/419		
Applicant NGK SPARK PLUG CO., LTD.		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 6 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 7 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
- This report contains indications relating to the following items:
 - ☒ Box No. I Basis of the report
 - ☐ Box No. II Priority
 - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - ☐ Box No. IV Lack of unity of invention
 - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - ☐ Box No. VI Certain documents cited
 - ☐ Box No. VII Certain defects in the international application
 - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand 25 March 2004 (25.03.2004)	Date of completion of this report 25 November 2004 (25.11.2004)
Name and mailing address of the IPEA/JP	Authorized officer
Facsimile No.	Telephone No.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/JP2003/010887

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- ☐ This report is based on translations from the original language into the following language _____, which is language of a translation furnished for the purpose of:
- ☐ international search (under Rules 12.3 and 23.1(b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

- ☐ The international application as originally filed/furnished

- ☒ the description:

pages _____ 1-6, 8-25 _____, as originally filed/furnished

pages* _____ 7-7/1 _____ received by this Authority on _____ 08 September 2004 (08.09.2004)

pages* _____ received by this Authority on _____

- ☒ the claims:

pages _____ 9-12 _____, as originally filed/furnished

pages* _____, as amended (together with any statement) under Article 19

pages* _____ 1, 3, 4, 7, 8, 13 _____ received by this Authority on _____ 08 September 2004 (08.09.2004)

pages* _____ received by this Authority on _____

- ☒ the drawings:

pages _____ 11-11/11 _____, as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☒ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☒ the claims, Nos. _____ 2, 5, 6 _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

PCT/JP 03/10887

1.	Statement
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Novelty (N)	Claims	<u>1, 3, 4, 7, 8, 9, 10, 11, 12, 13</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>7, 8, 9, 10, 11, 13</u>	YES
	Claims	<u>1, 3, 4, 12</u>	NO
Industrial applicability (IA)	Claims	<u>1, 3, 4, 7, 8, 9, 10, 11, 12, 13</u>	YES
	Claims		NO

Document 1: JP 2002-236105 A (Robert Bosch GmbH), 23 August 2002, entire text; fig. 1 & US 2002/0053233 A1 & DE 10058013 A

Document 2: JP 2001-343356 A (Denso Corp.), 14 December 2001, entire text; fig. 12 & US 2001/0025522 A1

Document 3: JP 2001-99807 A (NGK Spark Plug Co., Ltd.), 13 April 2001, entire text; fig. 1-11 & EP 978721 A1 & US 6346179 B1

Documents 1 and 2 cited in the international search report disclose a gas sensor comprising a gas sensor element extending in an axial direction and having a gas contact portion at the tip thereof which comes into contact with the gas being measured; a case encompassing the aforementioned gas sensor element radially in such a manner that the aforementioned gas contact portion protrudes downwards out from the tip; and a cylindrical protector having a bottom portion and fixed to the aforementioned case in such a manner that the gas contact portion of the aforementioned gas sensor element is covered, wherein said protector is provided with an inner cylindrical unit and an outer cylindrical unit positioned

concentrically within the side walls of the inner cylindrical unit with a gap maintained therebetween; the aforementioned inner cylindrical portion is formed to have a bottom and, in addition the aforementioned outer cylindrical unit is formed to have a bottom; the aforementioned inner cylindrical unit is inserted into an insertion hole provided in the bottom wall of the aforementioned outer cylindrical unit; the bottom wall of the inner cylindrical unit protrudes towards the tip side beyond the bottom wall of the outer cylindrical unit; the bottom wall of the outer cylindrical unit is positioned at the tip of the protector and a plurality of outer-wall gas inlet openings are formed in the side wall of the outer cylindrical unit to allow the introduction of the gas to be measured into the aforementioned gap; a plurality of inner-wall gas inlet openings are formed in the side wall of the inner cylindrical unit and positioned closer to the aforementioned case than the outer-wall gas inlet openings to allow the gas to be measured to be introduced to the periphery of the aforementioned gas contact portion; the outer peripheral surface of the side wall of the inner cylindrical unit at the position opposite to the outer-wall gas inlet openings is formed in such a manner as to be parallel to the outer peripheral surface of the side wall of the outer cylindrical unit; a discharge opening is formed in the aforementioned bottom wall positioned at the tip of the protector to allow the gas being measured, which has been introduced into the internal part of the inner cylindrical unit, to be directly discharged to the outside of the protector; and the side wall of the inner cylindrical unit that protrudes on the tip side beyond the bottom wall of the outer cylindrical unit is formed into a tapered shape in such a manner that the outer diameter thereof decreases gradually towards the tip.

Document 3 cited in the international search report discloses a gas sensor provided with guide members provided to the inside edge of the gas inlet opening of the outer cylindrical body and extending to the inside thereof. Therefore, it would be easy for a person skilled in the art to apply this configuration to the gas sensor disclosed in documents 1 and 2.

Claim 4

Document 3 (fig. 8(f)) cited in the international search report discloses the feature wherein the bottom wall of the outer cylindrical unit is formed into a tapered shape in such a manner that the diameter thereof decreases gradually towards the tip. Therefore, there would be no technical difficulty posed in using this configuration to form the outer cylindrical unit of the gas sensor disclosed in documents 1 and 2.

Claims 7, 8, 9, 10, 11, 13

None of the documents cited in the international search report disclose or suggest the feature of forming a drain hole in the bottom wall of the outer cylindrical unit, said hole being positioned at a point to the outside in terms of the radial direction of the outer peripheral surface of the side wall of the inner cylindrical unit; and the feature wherein the bottom wall of the outer cylindrical unit has a first bottom wall that connects with the side wall of the outer cylindrical unit and a second bottom wall that is positioned further towards the tip than the first bottom wall, a discharge opening is formed in the aforementioned second bottom wall and a connecting side wall that joins the first bottom wall and the second bottom wall is formed in a tapered manner so that the outer diameter thereof gradually decreases

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.

PCT/JP 03/10887

towards the tip.

AMENDMENT UNDER ARTICLE 34

[0032] The invention set forth in claim 5 is characterized in that, in the gas sensor set forth in claim 1, the outer hollow-cylindrical portion is formed into a bottomed cylinder. A bottom wall of the outer hollow-cylindrical portion is positioned nearer to the front end than the inner hollow-cylindrical portion, so that the bottom wall of the outer hollow-cylindrical portion is made a bottom wall positioned at an utmost front end. It is preferable that the discharge opening is formed in the bottom wall of the outer hollow-cylindrical portion.

DT01 Rec'd PCT/PTC 25 FEB 2005

CLAIMS

1. (amended) A gas sensor comprising:

a gas sensing element extending in an axial direction, and having a gas contact part, which is brought into contact with a gas to be measured, at its front end;

a case that surrounds the gas sensing element in a radial direction in such a manner that the gas contact part protrudes from a front end of the case; and

a protector, formed into a bottomed cylinder, fixed to the case in such a manner that the protector covers the gas contact part of the gas sensing element, wherein

the protector is composed of an inner hollow-cylindrical portion, and an outer hollow-cylindrical portion which is provided coaxially with a side wall of the inner hollow-cylindrical portion with an air space in between,

the inner hollow-cylindrical portion is formed into a bottomed cylinder, the outer hollow-cylindrical portion is formed into a bottomed cylinder, the inner hollow-cylindrical portion is passed through an insertion hole provided in a bottom wall of the outer hollow-cylindrical portion, so that the bottom wall of the inner hollow-cylindrical portion protrudes nearer to the front end than the bottom wall of the outer

AMENDMENT UNDER ARTICLE 34

hollow-cylindrical portion, the bottom wall of this inner hollow-cylindrical portion being made a bottom wall positioned at an utmost front end of the protector,

plural number of outer-wall gas inlet openings are formed in a side wall of the outer hollow-cylindrical portion, with guiding bodies extending inward so that the gas to be measured is introduced to the air space,

plural number of inner-wall gas inlet openings are formed in the side wall of the inner hollow-cylindrical portion, the inner-wall gas inlet openings being arranged nearer to the case than the outer-wall gas inlet openings so that the gas to be measured is introduced around the gas contact part, and, an outer circumferential face of the side wall of the inner hollow-cylindrical portion positioned opposite to the outer-wall gas inlet openings is formed so as to be parallel to an outer circumferential face of the side wall of the outer hollow-cylindrical portion or so as to have a slope-like shape with a diameter enlarging in an axial direction toward the bottom wall of the protector, and

a discharge opening for discharging the gas to be measured, which is introduced to inside of the inner hollow-cylindrical portion directly to outside of the protector, is formed in the bottom wall positioned at the utmost front end of the protector.

AMENDMENT UNDER ARTICLE 34

2. (cancelled)

3. (amended) The gas sensor set forth in claim 1, wherein the side wall of the inner hollow-cylindrical portion, which protrudes nearer to the front end than the bottom wall of the outer hollow-cylindrical portion, has a taper part so that an outer diameter of the side wall becomes smaller toward the front end, and a protruding length of the inner hollow-cylindrical portion which protrudes from the bottom wall of the outer hollow-cylindrical portion and has the taper part is in a range from 1 mm to 5 mm.

4. (amended) The gas sensor set forth in claim 1, wherein the side wall of the inner hollow-cylindrical portion, which protrudes nearer to the front end than the bottom wall of the outer hollow-cylindrical portion, has a taper part so that an outer diameter of the side wall becomes smaller toward the front end, and the bottom wall of the outer hollow-cylindrical portion has a taper part so that that an outer diameter of the bottom wall becomes smaller toward the front end.

5. (cancelled)

AMENDMENT UNDER ARTICLE 34

6. (cancelled)

7. (amended) The gas sensor set forth in one of claims 1 to 4, wherein at least one drain hole is formed in a part, in the bottom wall of the outer hollow-cylindrical portion, which is positioned nearer to outside in a radial direction than the outer circumferential face of the side wall of the inner hollow-cylindrical portion.

8. (amended) The gas sensor set forth in one of claims 1 to 4, wherein

a drain hole is formed in a region of the side wall of the inner hollow-cylindrical portion which is positioned inside of the outer hollow-cylindrical portion, and

the drain hole is formed in such a manner that a front side edge, of an inner periphery of the drain hole, which is positioned at the front end in the axial direction of the protector is positioned nearer to the front end in the axial direction of the protector than a rear side edge, of an inner periphery of the outer-wall gas inlet opening positioned at an utmost front end of the side wall of the outer hollow-cylindrical portion, which is positioned at a rear end in the axial direction of the protector.

AMENDMENT UNDER ARTICLE 34

9. The gas sensor set forth in claim 8, further comprising

a second guiding body, one end of which is connected to the rear side edge of the inner periphery of the drain hole and the other end of which extends with an inclination so as to come close to a center, in a radial direction, of the protector from the rear side edge of the drain hole toward the front end of the protector.

10. The gas sensor set forth in claim 8, wherein a notch crossing to the axis of the protector is provided in a part of the side wall of the inner hollow-cylindrical portion, and a region at the rear end in the axial direction of the protector from this notch is stuck out inward in the radial direction in such a manner as to continue to the side wall of the inner hollow-cylindrical portion, thereby, forming the second guiding body extending in the axial direction of the protector and the drain hole.

11. The gas sensor set forth in one of claims 8 to 10, wherein plural number of drain holes are provided in the side wall of the inner hollow-cylindrical portion, and

a total opening area of the plural number of drain holes is smaller than a total opening area of the plural number of inner-wall gas inlet openings.

AMENDMENT UNDER ARTICLE 34

12. The gas sensor set forth in one of claims 1 to 11, wherein

an angle of the guiding bodies extending from end parts of the outer-wall gas inlet openings is formed inward in a range from 35° to 70°, relative to a tangent line of an outer circumference of the outer hollow-cylindrical portion.

13. (added) A gas sensor comprising:

a gas sensing element extending in an axial direction, and having a gas contact part, which is brought into contact with a gas to be measured, at its front end;

a case that surrounds the gas sensing element in a radial direction in such a manner that the gas contact part protrudes from a front end of the case; and

a protector, formed into a bottomed cylinder, fixed to the case in such a manner that the protector covers the gas contact part of the gas sensing element, wherein

the protector is composed of an inner hollow-cylindrical portion, and an outer hollow-cylindrical portion which is provided coaxially with a side wall of the inner hollow-cylindrical portion with an air space in between,

the outer hollow-cylindrical portion is formed into a

AMENDMENT UNDER ARTICLE 34

bottomed cylinder, and a bottom wall of the outer hollow-cylindrical portion is disposed nearer to the front end than the inner hollow-cylindrical portion, so that the bottom wall of the outer hollow-cylindrical portion is made a bottom wall positioned at an utmost front end of the protector,

plural number of outer-wall gas inlet openings are formed in a side wall of the outer hollow-cylindrical portion, with guiding bodies extending inward so that the gas to be measured is introduced to the air space,

plural number of inner-wall gas inlet openings are formed in the side wall of the inner hollow-cylindrical portion, the inner-wall gas inlet openings being arranged nearer to the case than the outer-wall gas inlet openings so that the gas to be measured is introduced around the gas contact part, and, an outer circumferential face of the side wall of the inner hollow-cylindrical portion positioned opposite to the outer-wall gas inlet openings is formed so as to be parallel to an outer circumferential face of the side wall of the outer hollow-cylindrical portion or so as to have a slope-like shape with a diameter enlarging in the axial direction toward the bottom wall of the protector,

a discharge opening for discharging the gas to be measured, which is introduced to inside of the inner hollow-cylindrical portion directly to outside of the

AMENDMENT UNDER ARTICLE 34

protector, is formed in the bottom wall positioned at the utmost front end of the protector,

the bottom wall of the outer hollow-cylindrical portion is composed of a first bottom wall which is connected to the side wall of the outer hollow-cylindrical portion, and a second bottom wall disposed nearer to the front end than the first bottom wall, the discharge opening being formed in the second bottom wall, and a connecting side wall that connects the first bottom wall and the second bottom wall has a taper part so that an outer diameter of the connecting side wall becomes smaller toward the front end.

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